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# A Contextual Framework For Standards

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## ABSTRACT

This paper describes a layered approach to selection and use of open standards which is being developed to support development work within the UK higher and further educational communities. This approach reflects the diversity of the technical environment, the service provider's environment, user requirements and maturity of standards by separating contextual aspects; technical and non-technical policies; the selection of appropriate solutions and the compliance layer. To place the layered approach in context, case studies are provided of the types of environments in which the standards framework can be implemented.

The paper describes how this contextual approach can be extended to address other areas such as Web accessibility and use of open source software. Use of a common model can provide consistent approaches by funding bodies and shared understanding for developers.

This contextual approach is being extended to support development work with other public sector organizations within the UK. We describe how the approach is well-suited to ensure common ways of working across disparate sets of organizations and how the approach can be applied within a wider context.

## Categories and Subject Descriptors

K.4.1 [Computers and Society]: Public Policy Issues

## General Terms

Standardization

## Keywords

open standards; policies; open source, e-learning, accessibility

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## 1. INTRODUCTION

The importance of open standards is order to provide application- and device-independence, to help ensure the interoperability of services and to maximize access to resources is widely acknowledged. The Web, for example, is widely accepted as the key platform for providing access to digital services and resources. The Web promises universal access to resources and provides flexibility (including platform- and application-independence) though use of open standards. In practice, however, it can be difficult to achieve this goal. Proprietary formats can be appealing and, as we learnt during the "browser wars", software vendors can state their support for open standards while deploying proprietary extensions which can result in services which fail to be interoperable.

Many development programmes which seek to provide access to digital resources will expect funded projects to comply with a variety of open standards. However if, in practice, projects fail to implement open standards this can undermine the premise that open standards are essential and would appear to threaten the return of application- and platform-specific access to resources.

Although a commitment to Web development based on open standards certainly is appealing, in practice it is likely that there will be occasions when use of proprietary solutions may be needed (for example, there may be areas in which open standards are not available or are not sufficiently mature for deployment in a service environment). But the acceptance of a mixed economy in which open standards and proprietary formats can be used as appropriate can lead to dangers with organizations continuing to deploy proprietary solutions they are familiar with.

So should we mandate strict compliance with open standards or should we tolerate a mixed economy? This paper seeks to explore these questions in more detail. The paper begins by reviewing examples of national development programmes in the UK which have an open standards philosophy and describes the limitations of the approaches taken. An alternative approach is described which is supportive of open standards but which provides a broader framework for the development of networked services. Examples of how this contextual approach is being used are provided. The paper concludes by describing how this approach can be extended across other areas and to other communities.

## 2. INITIAL APPROACHES TO USE OF OPEN STANDARDS IN THE UK

### 2.1 Standards In UK Higher And Further Education Development Programmes

The higher and further education communities in the UK have a culture which is supportive of open standards in its development programmes in order to reflect the diversity to be found across the sector. These principles underpin the development activities funded by the Joint Information Systems Committee (JISC), a national body which funds national IT services and development programmes for the UK's higher and further education communities. In 1999 JISC established the Learning and Teaching Programme with the aim of increasing use of online electronic resources. To ensure that the project deliverables could be easily deployed into a service environment the JISC expected projects to make use of standards documented in the *Standards and Guidelines To Build A National Resource* document [1], which was an updated version of the *eLib Standard Guidelines* document [2] which supported an early digital library programme, known as eLib, which ran from 1995 until 2001.

### 2.2 Standards In UK Cultural Heritage Development Programmes

The NOF-digitise programme formed part of a larger initiative (the New Opportunities Fund or NOF) that distributed funding to education, health and environment projects throughout the UK. The NOF-digitise element was, as the title suggests, was dedicated to funding and supporting universities, local government, museums and other public sector organizations in digitizing material from their collections and archives and making this cultural heritage available on the Web.

Emphasis on the need for standards and good practice began early in the lifespan of the programme. This was for two reasons. Firstly, few of the funded projects had much experience of digitization so education and training was required to inculcate the importance of standards. Secondly, it was realized that the public funding of a large-scale digitization programme entailed the creation of material that needed to be preserved and made accessible not just in the present, but for future generations. Therefore the programme elected to formulate a set of standards based on open standards. In addition a Technical Advisory Service was established which would be able to offer technical assistance to the projects as they applied these standards.

The standards developed for NOF-digitise projects [3] addressed five areas: creation, management, collection development, access and re-use. In many cases defining the open standards in these areas was a relatively straightforward matter. Thus those projects that were digitizing textual material needed to do so in XML or HTML; those creating digital images had to use formats such as TIFF, GIF, JPEG (JFIF) or PNG.

### 2.3 Standards In UK E-Government

The UK Government also seeks to make use of open standards to support interoperability. An e-GIF Technical Standards Catalogue has been published [4]. This document provides a catalogue of standards for use across government organisations. The catalogue assigns a status for each of the standards of *Adopted*; *Recommended*; *Under review* or *For Future consideration*.

## 3. DIFFICULTIES EXPERIENCED

### 3.1 Experiences In The UK Higher And Further Education Community

Although projects funded by the eLib programme were expected to comply with the eLib standards document, in practice compliance was never formally checked. This may have been appropriate at that time, before the Web was acknowledged as the prime delivery platform. However, there is now a realization that compliance with open standards such as XML is necessary in order for digital resources to be widely interoperable. JISC funded the QA Focus project to develop a quality assurance framework which would help ensure that future projects would comply with standards and recommendations and make use of best practices.

Focus groups provided feedback on the standards framework. The feedback indicated: (a) a lack of awareness of the standards document; (b) difficulties in seeing how the standards could be applied to projects' particular needs; (c) concerns that the standards would change during the project lifetime; (d) lack of technical expertise and time to implement appropriate standards; (e) concerns that standards may not be sufficiently mature to be used; (f) concerns that the mainstream browsers may not support appropriate standards and (g) concerns that projects were not always starting from scratch but may be building on existing work and in such cases it would be difficult to deploy appropriate standards. Many of these were legitimate concerns which needed to be addressed in future programmes.

### 3.2 Experiences With NOF-digitise Standards

Unlike the approaches taken by JISC, the NOF-digitise programme involved the use of an external standards compliance service. This approach taken required projects to report on any deviance from required standards. In addition a limited amount of checking of project Web sites was also carried out. Initial reports from some of the projects and discussion on mailing lists showed that there were occasions when full compliance with mandated standards was not felt to be possible or compliance would be likely to reduce the effectiveness or usability of the Web site. In order to address this the project reporting form was changed in order to allow projects to give reasons for non-compliance. In addition a FAQ was produced [5] which provided examples of permissible non-compliance.

The flexibility which was introduced helped the programme to produce valuable cultural heritage online services. However, on reflection, the approach taken to the support of the NOF-digitise programme had its limitations:

**Lack of embedding:** There is a danger that, since the standards document are provided by an external body, use of open standards will fail to be embedded in other development work within the organisations hosting project work.

**Lack of a QA framework:** Use of an external compliance checking service can result failure to develop a quality assurance framework.

**Difficulties in reuse of support materials:** The support materials which were developed (FAQs, briefing papers, etc.) were integrated with NOF-digitise procedural issues. This meant that it was difficult to reuse the materials to support other programmes.

### 3.3 Comments On E-GIF Standards

Although the e-GIF technical standards are mandatory for information exchange across many government organisations, there are a number of concerns over the approach taken.

**Limitations of the approach to the status of standards:** The catalogue assigns a status for each of the standards of Adopted; Recommended; Under review or For Future consideration. However this one-dimensional approach makes it difficult to reflect the diversity to be found.

**Lack of guiding principles:** The standards catalogue fails to describe the underling principles on which the document is based. Parts of the document appear to be based on use of open W3C standards, but in other areas proprietary formats have been adopted.

**Limited discussion:** Although an online discussion forum has been provided it has been little used.

## 4. A LAYERED APPROACH TO USE OF STANDARDS

We have described approaches which have been for use of open standards. We have described some of the limitations with these approaches and the confusions which can be caused through an over-simplistic mandation of open standards.

Where does this leave us? There is a danger that developers of networked services which seek to make use of open standards will be left in an uncertain position as to how best to proceed. Should the commitment to open standards be abandoned due to the inherent difficulties? Should such difficulties be ignored and use of open standards be formally required? In [6] the authors argue for an open standards culture which is supportive of the use of open standards, but acknowledges the difficulties. In this paper the authors describe an approach which builds on this.

We argue that there is a need to recognize the contextual nature to this problem; i.e. there is not a universal solution, but rather the need to recognize local, regional and cultural factors which will inform the selection and use of open standards. We have developed a layered approach intended for used in development work. This approach is illustrated in Figure 1.

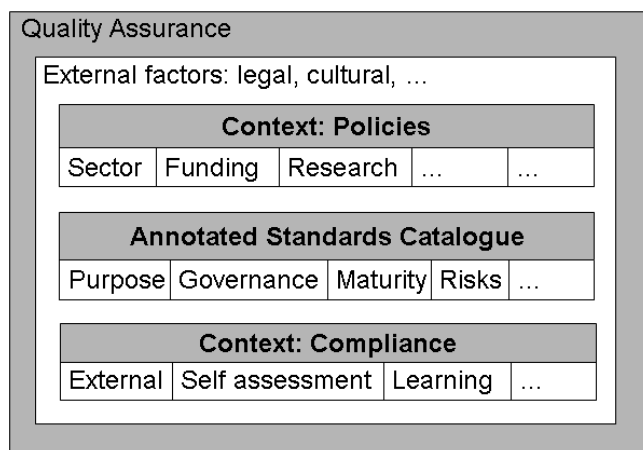


Figure 1: A layered approach to use of standards

This approach uses the following layers:

**Contextual Layer: Policies:** This reflects the context in which the standards are being used. Large, well-funded

organizations may choose to mandate strict use of open standards in order to build large, well-integrated systems which are intended for long term use. For a smaller organization, perhaps reliant on volunteer effort with uncertain long-term viability, a simpler approach may be more appropriate, perhaps making use of proprietary solutions.

**Annotated Standards Catalogue:** This provides an annotated description (or catalogue) of relevant policies in a range of areas. The areas will include descriptions of standards, the ownership, maturity, risk assessment, etc.

**Contextual Layer: Compliance:** This describes the mechanisms which will be used in order to ensure that development work complies with the requirements defined within the particular context. For large, public funded programmes there could be a formal monitoring process carried out by external auditors. In other contexts, projects may be expected to carry out their own self-assessment. In such cases, the findings could be simply used internally within the project, or, alternatively, significant deviations from best practices could be required to be reported to the funding body.

It should be noted that, although it will be possible to deploy this three-layered approach within a funding programme or community, there will be a need to recognize external factors, over which there may be no direct control. This may include legal factors, wider organizational factors, cultural factors, etc.

## 5. USING THIS APPROACH

### 5.1 Application To Digitization

As an archive with over ten years experience of handling digital objects, the work of the Arts and Humanities Data Service (AHDS) illustrates the importance of open standards but the difficulties (and the resulting need for pragmatism) in trying to apply them. The task of the AHDS is to collect, disseminate and preserve digital resources in the arts and humanities. Typically these resources consist of digital texts, still images, audio or video files, etc, which are created by academics in UK universities, who then deposit these materials with the AHDS. The AHDS has sought to identify suitable formats for the long-term preservation of digital data. This manifests itself in an *AHDS Deposit Format list* [7]. This list and related resources - notably *Guides to Good Practice* [8] and *Information Papers* [9] - stipulate the formats which should be utilized by resource creators for digitization.

To facilitate preservation, the AHDS recommends the use of open standards - non-proprietary formats that will help maintain free and reasonably straightforward access to digital data, hopefully unaffected by changes in the global computing environment. For the most straightforward data types, such as text and still images, this is a reasonably easy task to accomplish. For text use of XML is recommended; for still images, uncompressed TIFFs. Yet there is a realization that not all resource creators work according to pre-set standards. Often, this is due to a lack of understanding about the importance of standards, meaning that resource creation projects begin working immediately in the format that is most convenient in the short term, unaware of the long-term issues. In other cases, resource creators will be familiar with particular software and will want to continue to work with it, even if it does not cope well with open formats.

Thus the AHDS Deposit Format list, besides containing a set of Preferable Formats for depositing resources, comprises a list of Acceptable Formats as well. One example where this is relevant is word-processed documents. The preferred format for such

documents is RTF (Rich Text Format). This has long-term preservation value whereas a document that has been created in the native proprietary format (e.g. MS Word) does not. However, AHDS realizes that such applications are widely used and that it is easy to export data from MS Word into an RTF file. The AHDS therefore accepts MS Word files from resource creators and then migrates them into RTF on arrival at the AHDS archive.

This need for flexibility is particularly true when it comes to data types where there are no established open standards. Virtual reality, GIS, audio and video are areas where a pragmatic approach is required. For some of these data types open standards do exist. However, for a variety of reasons, it is not possible for the AHDS to stipulate only these as the preferred deposit format - indeed in some cases the open standard is not even considered the preferred standard within the communities who deal with the data type.

Formats for moving images provide a good example of this. Currently there is no ideal format for preservation, but there are numerous acceptable formats. Among these are Microsoft's AVI (Audio Video Interleaved) format and members of the family of MPEG (Moving Picture Experts Group) formats, particularly MJPEG, and MPEG-2, which is used as the standard for the delivery of moving images on DVDs. While these formats allow for high-quality digital moving images to be created, they are all proprietary formats; patents to the algorithms underlying the formats are owned by the formats' creators and must be licensed by commercial software developers in order to manipulate them.

With such proprietary formats, there is an obvious preservation risk. The patent-holders' business plans may change, affecting how such video files can be edited and played. It may be that users would have to pay in order to access files in that format, or, should some kind of corporate disaster (liquidation, being taken over by another company, etc.) strike, it could gradually become impossible to access moving image files in that format at all.

There are however advantages to these formats. Issues relating to the formats are well-documented and they have good acceptance in various communities around the world. Apple's QuickTime is another format that, because of its popularity and its ease of handling, is regarded as an acceptable format for depositing material with the AHDS; to reject QuickTime files would be to reject much of the digital moving image data currently being created. While the AHDS would like to mandate only open standards for data creation, the actual practices of the wider communities that the AHDS works with mitigates against this.

Because such formats are continually in flux, the situation requires proactive preservation management from the AHDS. The AHDS needs to ensure it keeps up-to-date with changes in format technology and their uptake. Should a new version of the MPEG format be released, the AHDS has to ensure that it obtains appropriate software to play the files and also migrate the files from the older version of the format to the newer. Developments in other formats also need to be tracked, such as MJPEG-2000. The process of setting standards for digitization is one that always needs to be reassessed and updated - it is not possible to mandate a particular set of open standards and expect them to become set in stone.

## 5.2 Application To E-Learning

The Centre for Technological Interoperability Standards (CETIS) represents the UK higher and further education institutions on international learning technology standards initiatives. CETIS has

been instrumental in the development of the JISC e-framework which is being deployed across JISC activities. The e-framework makes use of Web Services and a Service Oriented Architecture (SOA), together with the application of open learning technology specifications and standards such as those developed by the specification bodies such as the IMS Global Learning consortium and ADL and formal standards bodies including The British Standards Institute (BSI) and the International Standards Organization (ISO) the Institute of Electrical Engineers (IEEE).

As we will see, the three-layered contextual approach described above could equally be applied to the use of open learning technology standards. Historically, the lack of recognition of these factors have in some cases resulted in the mandation of specifications; prematurely, where the specification is an early iteration, inappropriately, where the specification is applied out of context and without due consideration of institutional, legal (particularly Intellectual Property Rights issues) and cultural considerations.

The adoption of a specification, either formal or *de facto*, is subject to an often lengthy life cycle which involves a lengthy iteration process before they are of "useable" value. To mandate an immature specification (one that is in the early stages of its adoption life cycle) in this process can result in the specification not accommodating community or project requirements for use.

A good example of inappropriate mandating has been the widespread application of the ADL Shareable Content Object Reference Model (SCORM) to content development. SCORM was designed contextually as a specification where detailed complex "tracking" of learner activities, responses and assessment are required, as required when training aircraft engineers et al where compliance is a key driver. It would be clearly inappropriate to apply SCORM in a Higher Education setting with an emphasis on a constructivist or collaborative approach to learning, where in context "compliance" assumes little or no importance.

Cultural barriers to the use of standards exist as is the case with the current drive at a policy level towards e-Portfolio or the European Diploma supplement (EDS) supported by open specifications such as IMS Learner Information Profile, UK LEAP, etc. Cultural concerns surround issues such as ownership of and access to the data contained in the portfolio, the validation and security of data which in turn impact on both institutional, student records and admissions, and legal, data protection and freedom of information factors.

## 6. THE DEVELOPER'S PERSPECTIVE

The layered approach described above has been designed to provide a framework for the use of standards with development programmes which, whilst supportive of use of open standards, acknowledges that this may not always be possible. How, though, is this approach to be used by projects?

We have developed another layered approach for use by projects which is illustrated in Figure 2.

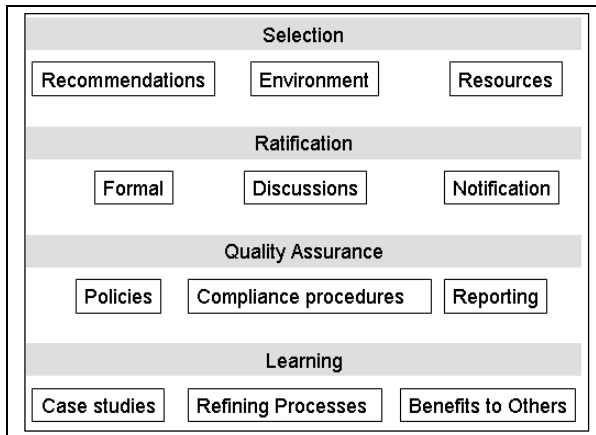


Figure 2: The Project's Perspective

Projects will be aware of four distinct phases, two which take place during the initial project development period, one during development work and one which takes place towards the end of the project's life:

**Selection:** In many cases projects will have some flexibility in choosing standards. The selection process should reflect the open standards culture inherent in the programme, whilst allowing some flexibility which reflects the content of the development environment. A matrix for the selection of standards has been developed to support this decision-making process [10].

**Ratification:** A potential danger could be that projects seek to use the methodology as an excuse to continue to use existing formats, tools and working practices. In order to avoid such inertia there should be a ratification stage, in which the decisions made by the projects can be agreed or rejected by the programme funders.

**Quality Assurance:** Projects will need to implement quality assurance procedures to ensure that the policies which have been made are being implemented correctly. A lightweight QA framework [11] has been developed to support JISC's development programmes.

**Review/Learning:** The final stage is for a review of the process which can provide an opportunity for learning. Projects should provide feedback on both the approach used across the digital library programme and on specific aspects, such as comments on particular technologies and standards.

## 7. EXTENDING THE APPROACH

### 7.1 Application To Web Accessibility

The importance of broad accessibility to digital resources is widely acknowledged. Within the World Wide Web Consortium (W3C) the Web Accessibility Initiative (WAI) has taken the lead in promoting the importance of accessibility and has developed a set of guidelines (the Web Content Accessibility Guidelines or WCAG) which, along with the guidelines for authoring tools and user agents, aim to provide guidance on best practices for ensuring that Web resources are widely accessible.

It would appear that a globally acknowledged standard for accessibility has been developed and that the WAI guidelines should be adopted by all. In reality, however, the approach developed by WAI has flaws. The WAI model, which is based on three components (guidelines for authoring tools and user agents,

in addition to guidelines for Web content), is a theoretical model for Web authors, as they have no control over the provision of browsers or authoring tools.

As well as the flaws in the WAI model, the WCAG guidelines themselves are flawed. Kelly *et al* [12] have argued that the poor level of compliance with WCAG guidelines which has been observed in many sectors reflects, not necessarily a lack of motivation to support users with disabilities but rather a failing in the guidelines themselves.

In the light of these issues the authors feel that a slavish commitment to WAI guidelines is inappropriate and that an alternative approach is needed. A holistic framework (shown in Figure 3) for e-learning accessibility has been developed by [13] which takes a user-focused approach to Web accessibility, rather than the conventional checklist approach.



Figure 3: Holistic Framework For E-Learning Accessibility

### 7.2 Application To Open Source

Open source development and deployment in UK academia is influenced by two policy documents and a set of peer-maintained standards. The JISC issued a policy on open source in 2005 [14] which expands on the UK government policy [15]. The peer standards consist of the terms of the Open Source Definition [16].

The effect of the policy documents is, firstly, to mandate consideration of open source software (OSS) solutions alongside proprietary ones in IT procurements; and secondly, to mandate that software developed with public funds should specify an exploitation route. Both documents say that an open source licence should be the default exploitation route if no other is proposed.

The policies lead some readers to suppose that both the JISC and the UK Government *demand* the use of open source software in all activities and *force* open source release on all projects. However, the effect is in fact closer to the contextual model discussed in this paper. For deployment, the insistence is that open source software should be considered on its merits without prejudice, and for development, that a proper assessment is made of the best way to manage release of intellectual assets. In deployment, this means that adherence to standards, fitness for purpose and value for money are the prime considerations; but the benefits of the open source system must be well understood in order to apply the appropriate weighting. In development, again, it is important to fully appreciate the benefits that the open source development model brings. In context, this may well mean that the public interest is served by the majority of software developed with public money comes under an open source licence. The UK e-Science and middleware programmes, for example, are areas of rapid innovation where shared resource can benefit everyone.

The situation is slightly different with the OSI definition of open source. The insistence here is that self-certification of conformance is not acceptable, unless "open source" is simply to become a fashion statement. However, there is no ranking of licenses to say that, for instance, the GPL is preferable to BSD.

This again provides the contextual model: a license should be chosen to suit the circumstances, but it should be chosen from amongst those supported by the community.

The message of the open source policies and standards is that the benefits of open source should be understood and taken account of, not that OSS should be given preferential treatment.

### 7.3 An Enhanced Contextual Model

We have seen how the contextual approach which has been developed to support the selection and use of open standards can be applied in other areas including accessibility and open source software. Figure 4 illustrates how the contextual model can be extended to other areas.

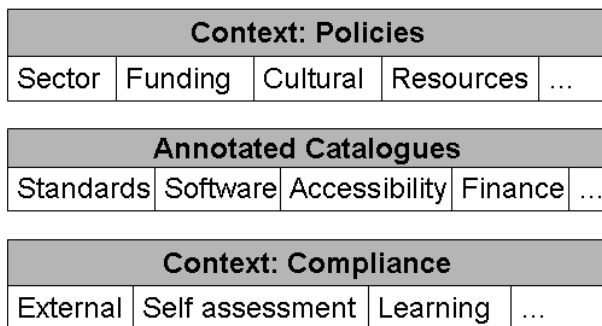


Figure 4: Enhanced contextual model

This model encourages the development of catalogues which provide summaries of appropriate best practices. Decisions of use of such best practices can then be determined within the context of the sector concerned, resources and funding available, etc.

It should be noted that this contextual approach is based on the notion of *subsidiarity* [17] – the principles of best practices are defined and document but decisions on implementing such best practices are developed, allowing the use of solutions which are applicable within their own particular context.

This approach is currently being used to extend the model developed for use by the JISC to include strategic partners in the Common Information Environment (CIE) [18]. The vision of the CIE is to allow users to seamless access to resources provided by a range of educational, cultural heritage and related public sector organisations within the UK. The contextual approach described in this paper is felt to be well-suited for use by the CIE, in order to reflect the diversity to be found across these organisations.

## 8. CONCLUSIONS

This paper has considered some of the difficulties associated with the use of open standards and describes a model which provides a contextual approach to selection and use of open standards within digital library development programmes. This model aims to provide a pragmatic solution and is designed to provide guidance and support for projects and services in implementing standards-based solutions, without being overly prescriptive. This model is currently being adopted within JISC and its potential for use in other contexts is being explored.

## 9. ACKNOWLEDGEMENTS

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